SEMESTER EXAMINATION DECEMBER-2023

Course Name: - B.TECH(CS) **Semester:- 5**

Paper Name: - Formal Language & Automata Theory **Paper Code:- TCS-505**

Time - 3 Hrs + 20 minutes per hour extra time for V.I. & examinees with writer. **Max Marks-70**

समय– 3 घण्टे + 20 मिनट प्रति घंटे अतिरिक्त–दृष्टिबाधित एवं सह लेखक परीक्षार्थियों के लिए। अधिकतम अंक–70

Instructions:

- The question paper consists of three sections namely A, B, C. All sections are compulsory.
- Section A- Each question carries **3 mark. All questions are compulsory.**
- Section B- Answer any **5 out of 7** given questions in maximum one hundred fifty (150) words. Each question carries **7 marks.**
- Section C- Answer any **2 out of 3** given questions in maximum three hundred (300) words. Each question carries **10 marks.**

निर्देश:

- प्रश्न पत्र में तीन खण्ड अ, ब, व स हैं। सभी खण्ड अनिवार्य हैं।
- खण्ड–अ में प्रत्येक प्रश्न **तीन अंक** का है। **सभी प्रश्न अनिवार्य हैं।**
- खण्ड–ब में **सात प्रश्नों में से किन्हीं पाँच** प्रश्नों के उत्तर अधिकतम 150 शब्दों में दें। प्रत्येक प्रश्न **सात अंक** का है।
- खण्ड–स में **तीन प्रश्नों में से किन्हीं दो** प्रश्नों के उत्तर अधिकतम (250-300) शब्दों में दें। प्रत्येक प्रश्न **10 अंक** का है।

Section – A (खण्ड–अ)

Objective Questions(वस्तुनिष्ठ प्रश्न)

1. Answer all the following questions. **5x3 =15**

निम्नलिखित सभी प्रश्न अनिवार्य हैं।

i) Moore Machine is an application of:
   a) Finite automata with output
   b) Finite automata without output
   c) Pushdown automata
   d) None of these

ii) Which among the following are incorrect regular identities?
   a) $\varepsilon R=R$
   b) $\varepsilon^*=\varepsilon$
   c) $\Theta^*=\varepsilon$
   d) $R\Theta=R$

iii) A push down automaton employs _____ data structure.
   a) Queue
   b) Linked list
   c) stack
   d) hash table

iv) PDA is more powerful than
   a) Turing machine
   b) Finite automata
   c) Both a and b
   d) None of these

v) Which of the following can be used to simulate any Turing machine?
   a) Finite state automaton
   b) Universal Turing machine
   c) Counter machine
   d) None of these

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Section – B (खण्ड–ब)
Short Answer Questions (लघुउत्तरीय प्रश्न)

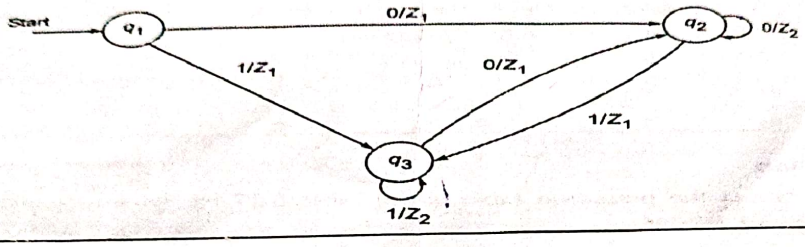
2. Answer any five of the following questions in maximum 150 words. **5x7=35**
निम्नलिखित में से किन्हीं पाँच प्रश्नों के उत्तर अधिकतम 150 शब्दों में दें।

i. Write a regular expression for the following set of elements over {a, b}

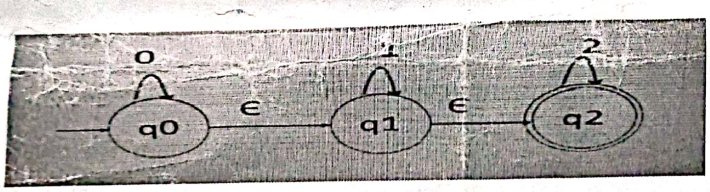
a) The set of all strings containing exactly 2 a's
b) The set of all strings containing at least 2a's
c)The set of all strings containing the substring aa.

ii. State and prove Arden's theorem for regular expression.

iii. Construct a Moore machine equivalent to the given mealy machine



iv. Convert the NFA with epsilon to NFA without epsilon



v. Find a grammar in CNF equivalent to the grammar
$S \rightarrow \sim S / [S \supset S] / p / q$ (S being the only variable)

vi. Show that the set of all strings over {a, b} consisting of equal no of a and b is accepted by a deterministic PDA.

vii. Consider the following productions:
$S \rightarrow aB / bA$, $A \rightarrow aS / bAA / a$, $B \rightarrow bS / aBB / b$
For the string aaabbabbba find
a) leftmost derivation b) rightmost derivation

Section – C (खण्ड–स)
Descriptive Questions (विवरणात्मक प्रश्न)

3. Answer any two of the following question in maximum 300 words. **2x10=20**
निम्नलिखित में से किन्हीं दो प्रश्नों के उत्तर अधिकतम 300 शब्दों में दें।

i) Construct a DFA with reduced state equivalent to the regular expression $10 + (0+11)0^*1$

ii) Design a Turing machine for the language $L = \{a^n b^n c^n / n \geq 1\}$

iii) Prove that the following language $L = \{ a^n b^n / n \geq 1\}$ is not regular using pumping lemma.

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